



M. Quinto

# TOTEM STATUS REPORT



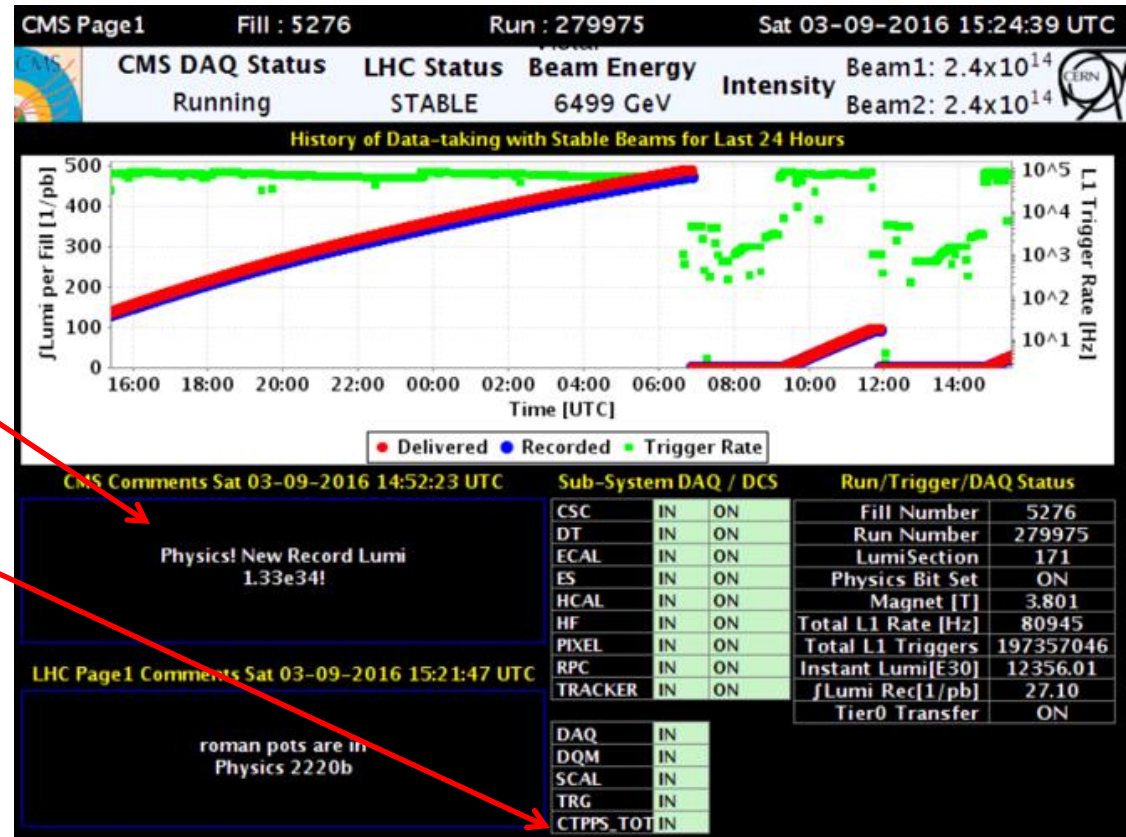
# Outline

- Strategy for 2017
- Summary of EYETS
  - Activities
  - Readiness
- Conclusions

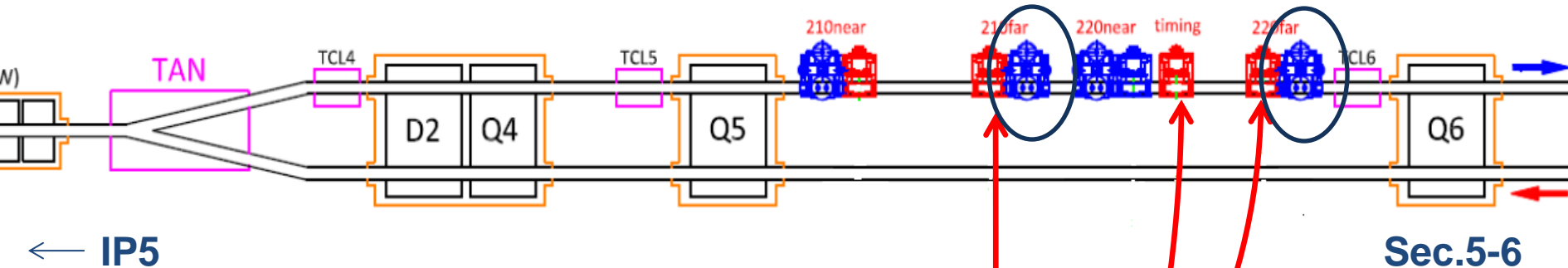


# CT-PPS 2016

- Roman Pot qualified for high lumi. insertion
- Insertion at LHC's record lumi. (so far)
- Global running with CMS DAQ
- $\sim 15\text{fb}^{-1}$  collected



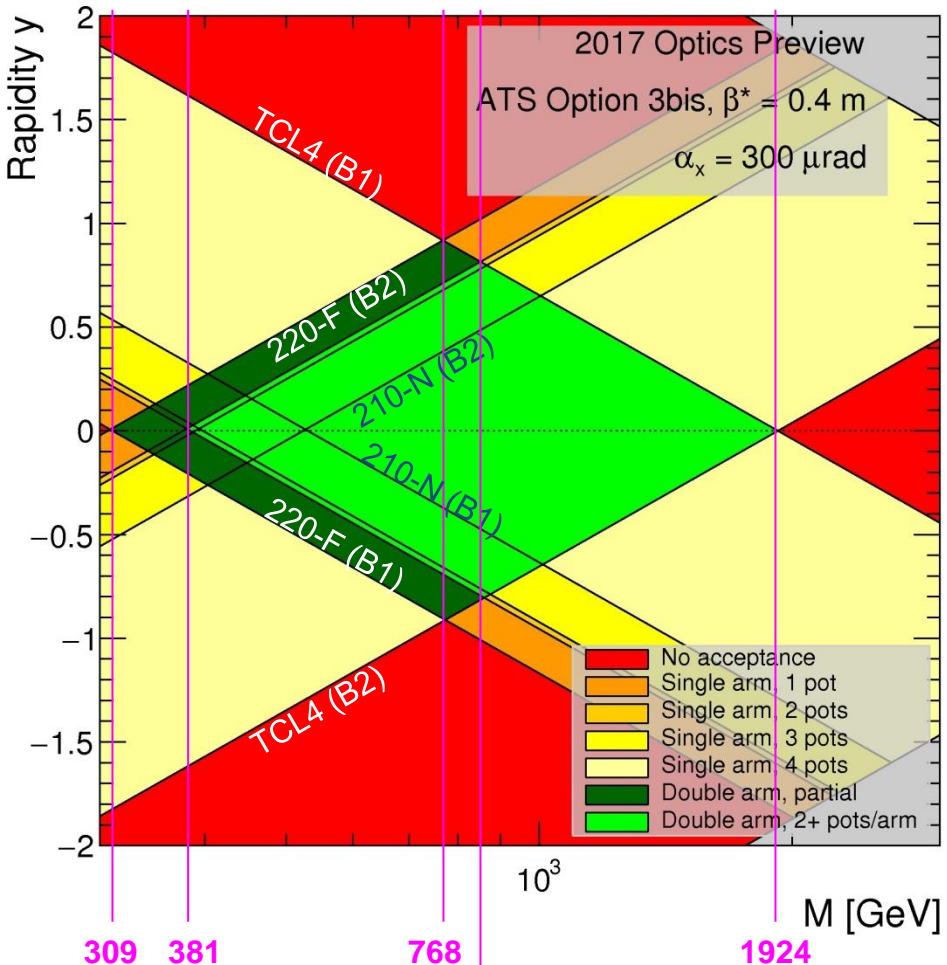
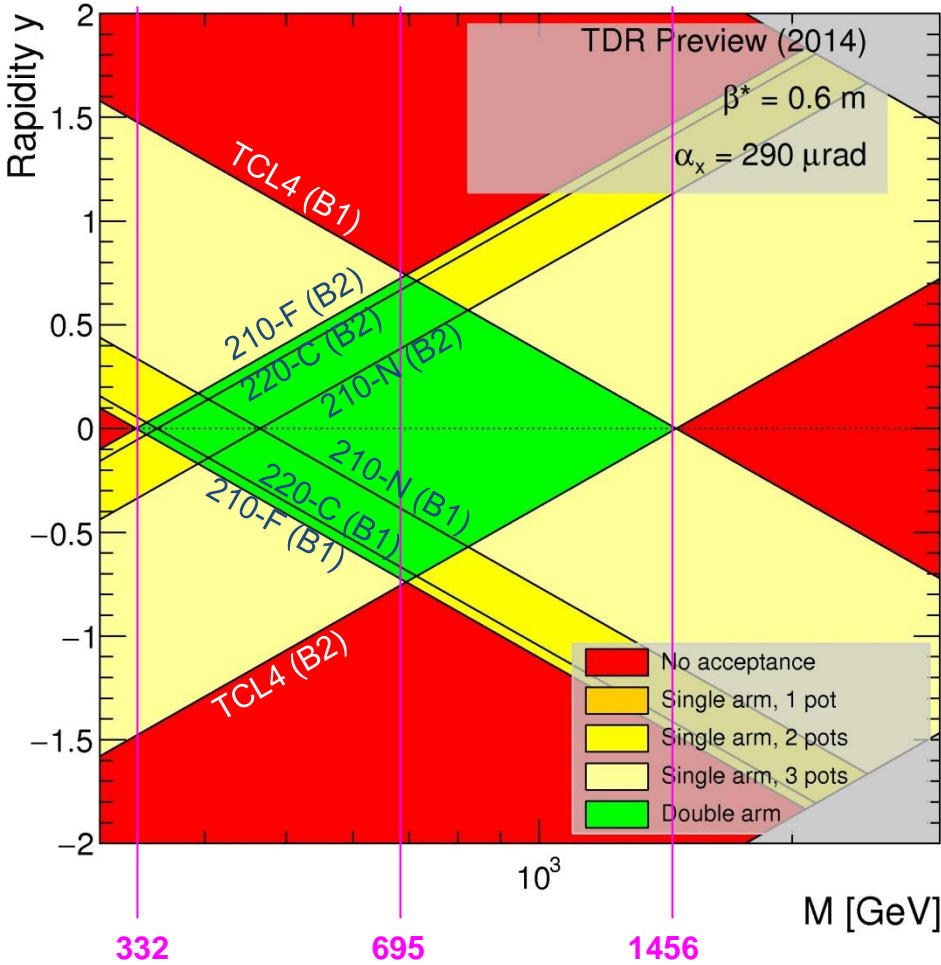
# Strategy during 2017



Extend the successful experience of 2016 with CT-PPS

- Insertion of 3 Horiz. RP for each side with 4 detector technologies:
  - 2 tracking: Si-Strip (210-FAR), Pixel (220-FAR)
  - 2 timing: hybrid Diamond + UFSD (cylindrical pot)
- Preparatory dedicated run for alignment and validation
  - 4 additional vertical pots inserted (in blue) to align the sensors w.r.t. the beam (elastic scattering events)
  - RP-210 NEAR insertion validation
- 220-FAR Horizontal Pot needed to be equipped with RF shield during EYETS  
-> Reduce impedance effect on the beam

# LHC Optics



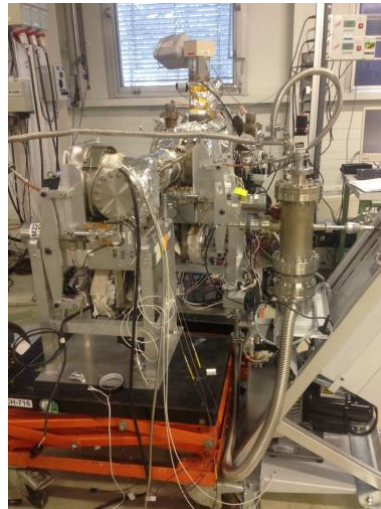
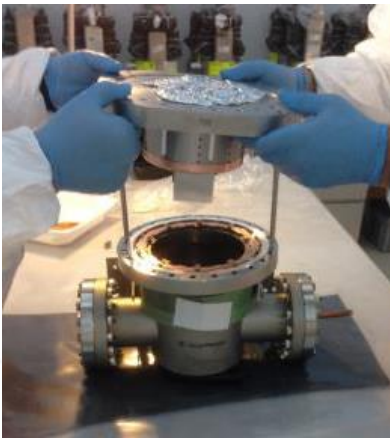
← Gain from 220-F upgrade (EYETS)  
 852

# Summary of EYETS

- Remove all detector packages -> inspection at SX5
- RP220-FAR removal, exchange ferrites, install RF shields and reinstallation
- Bake out of sectors 4/5 and 5/6 beam lines after reinstallation of pots
- Separate the secondary vacuum lines of the RP 210 & 220 to allow:
  - Warm mode cooling in RP220 near and RP cylindrical (timing)
  - Cold mode cooling RP220-FAR and RP210 (Pixel, Si-Strips)
- Installation of new LHC ion pumps
- Benchmarking of timing detector electronics - precision clock
- Diamond detector HV consolidation before re-installation
- Installation of timing, Si-Strips and Si-Pixel detector packages
- Integration of Si-Pixel detector in readout
- Re-commissioning with DAQ

# EYETS: RP220-FAR upgrade

- RF shield addition allows pot insertion at high luminosity
  - Pot removal
  - RF shield and ferrites insertion
  - Stand alone bake out & vacuum test
  - Reinstallation
  - Beam line bake-out -> all detectors to be removed from the beam line



# EYETS: Si-Strips

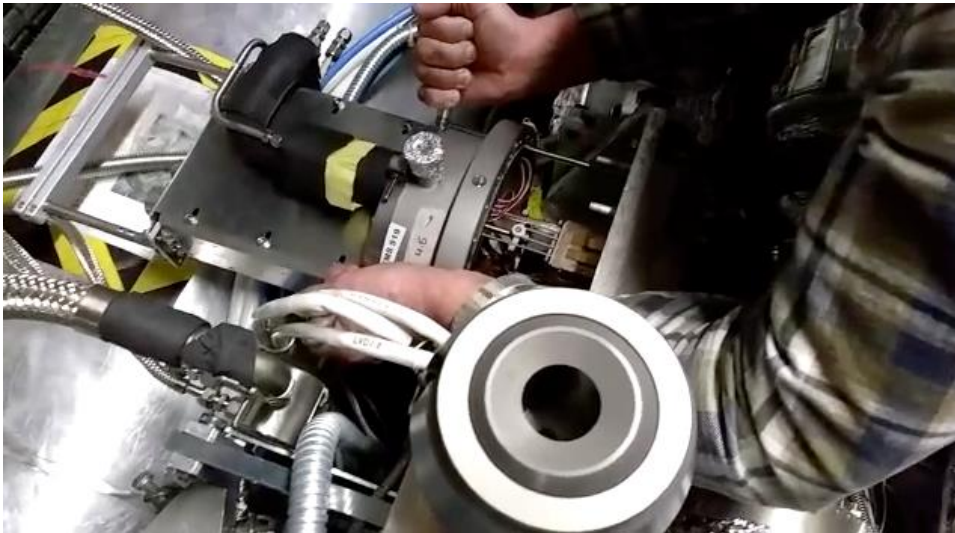
- 20 RP Si-Strip detector packages uninstalled, checked and stocked at SX5
- 10 Si-Strips reinstalled and validated
  - 220-FAR Vertical pots only in both sectors
  - 210-FAR Verticals and Horizontals in both sectors





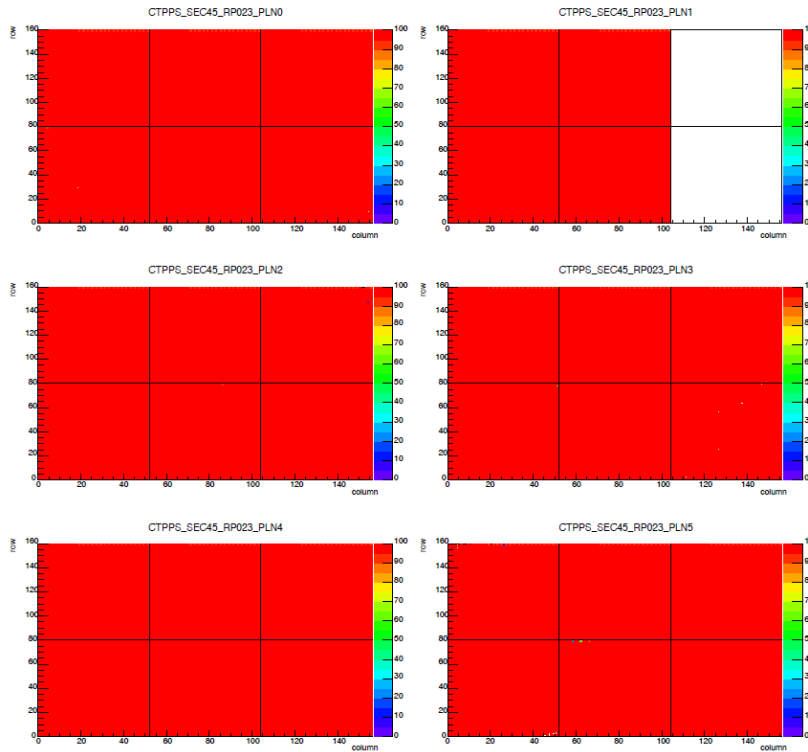
# EYETS: Si-Pixels

- 2 Pixel detector packages assembled and tested
- Installed in 220-FAR Horizontals (4-5 and 5-6)
  - Best acceptance for Physics
  - Improved radiation hardness
- Integrated in the  $\mu$ TCA readout chain

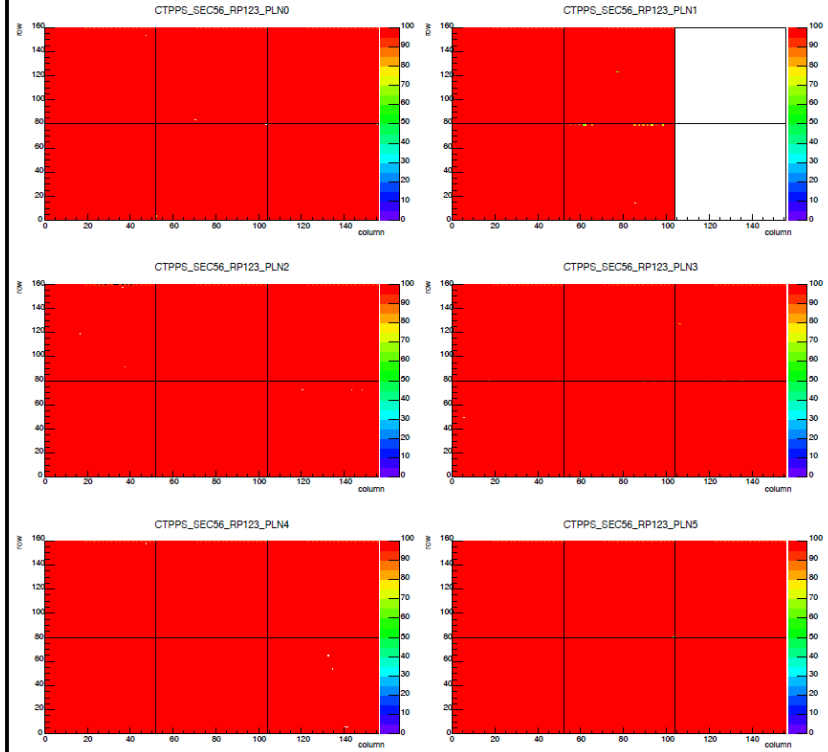


# EYETS: Si-Pixel (II)

## Module maps for SEC45



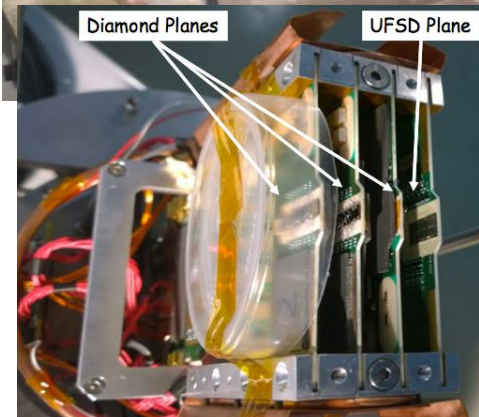
## Module maps for SEC56



- Pixel alive scan shows only 0.05% bad pixels in total

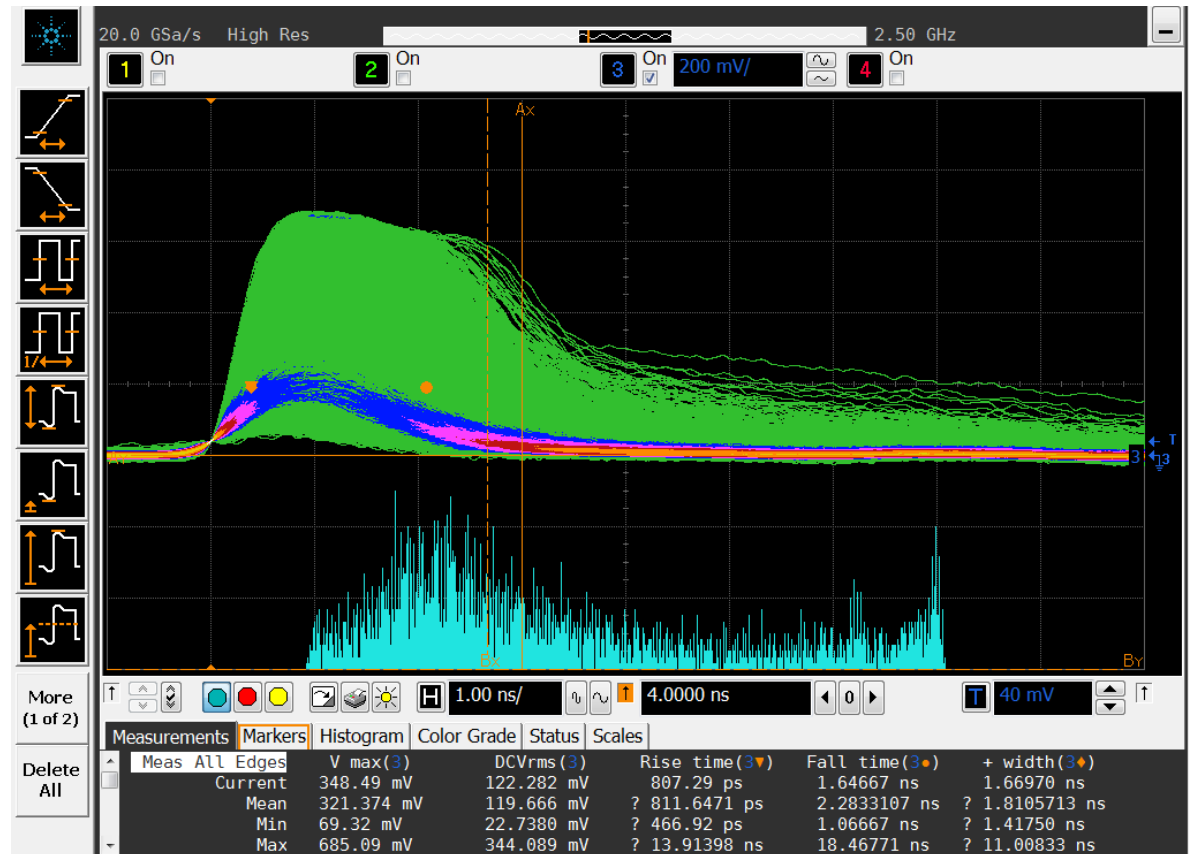
# EYETS: Timing

- Consolidation of timing det. hybrid
  - Discharge effect observed in 2016
  - Rework to mitigate HV discharge
- Replace 4<sup>th</sup> diamond plane with UFSD
  - Test of technology
  - Radiation effects evaluation
  - Transparent to the readout chain (NINO + HPTDC)
- Mechanical shift introduced on the hybrid
  - Improve position w.r.t. expected beam position
  - Additional vertical tuning possible by moving the full pot. If needed, during tech. stops.



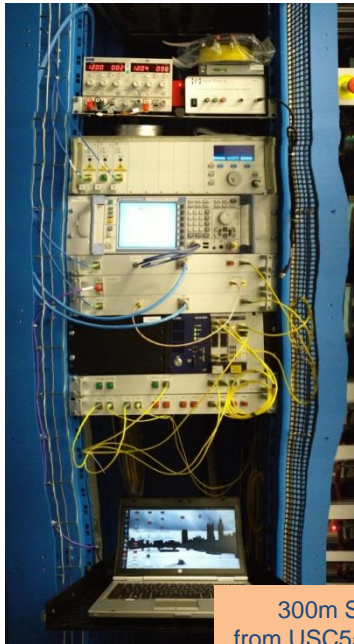
# EYETS: UFSD signal study

- UFSD sensors integrated with diamond hybrid
  - RT = 810ps
  - V max = 320mV
  - RMS noise = 5mV



# EYETS: Precision clock

- Precise optical clock
  - Installation of central distribution unit in USC55 completed
  - Receiving units already available in the tunnel



300m SM fiber from USC55 to sec.4-5 and 5-6



- Precise RF clock

- Master <-> Slave units reinstalled and tested into the tunnel



500m RF cable from sec.4-5 to sec.5-6

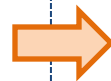
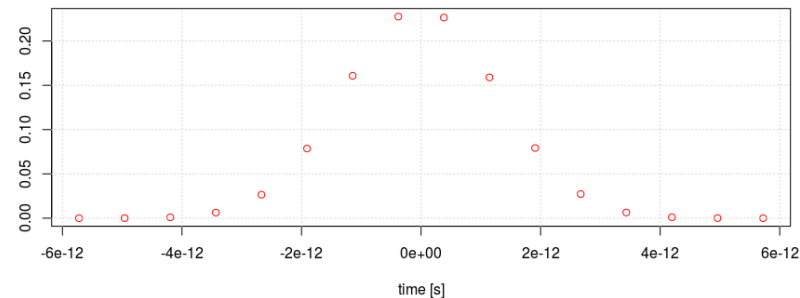


# EYETS: Precise clock (II)

- Optical clock commissioning
  - Check of fibers attenuation **3-4dB**
  - RMS jitter at source **~1ps**
  - RMS jitter at receivers **~2ps**

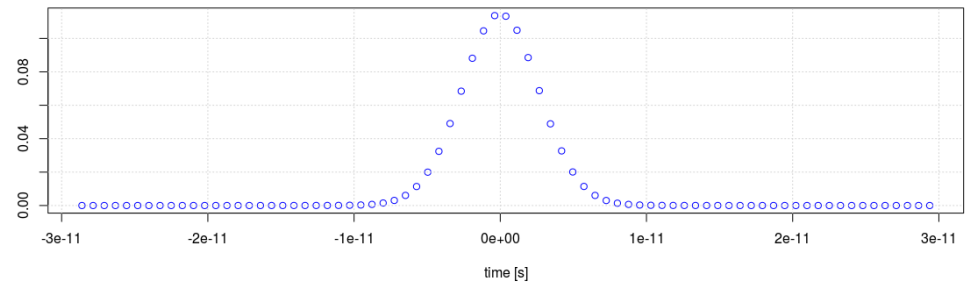
## CMS USC55

Source clock jitter - USC55

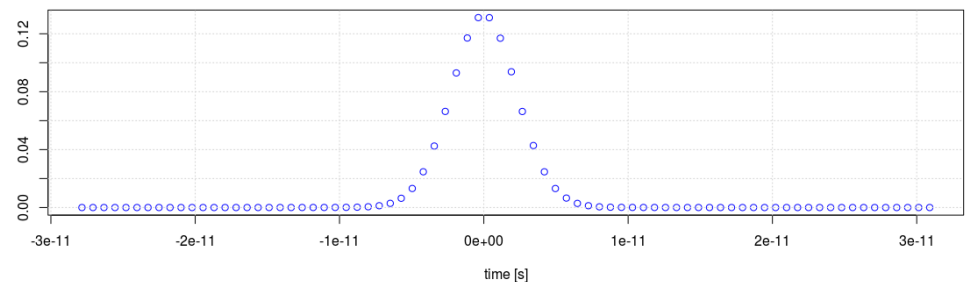


## LHC's tunnel

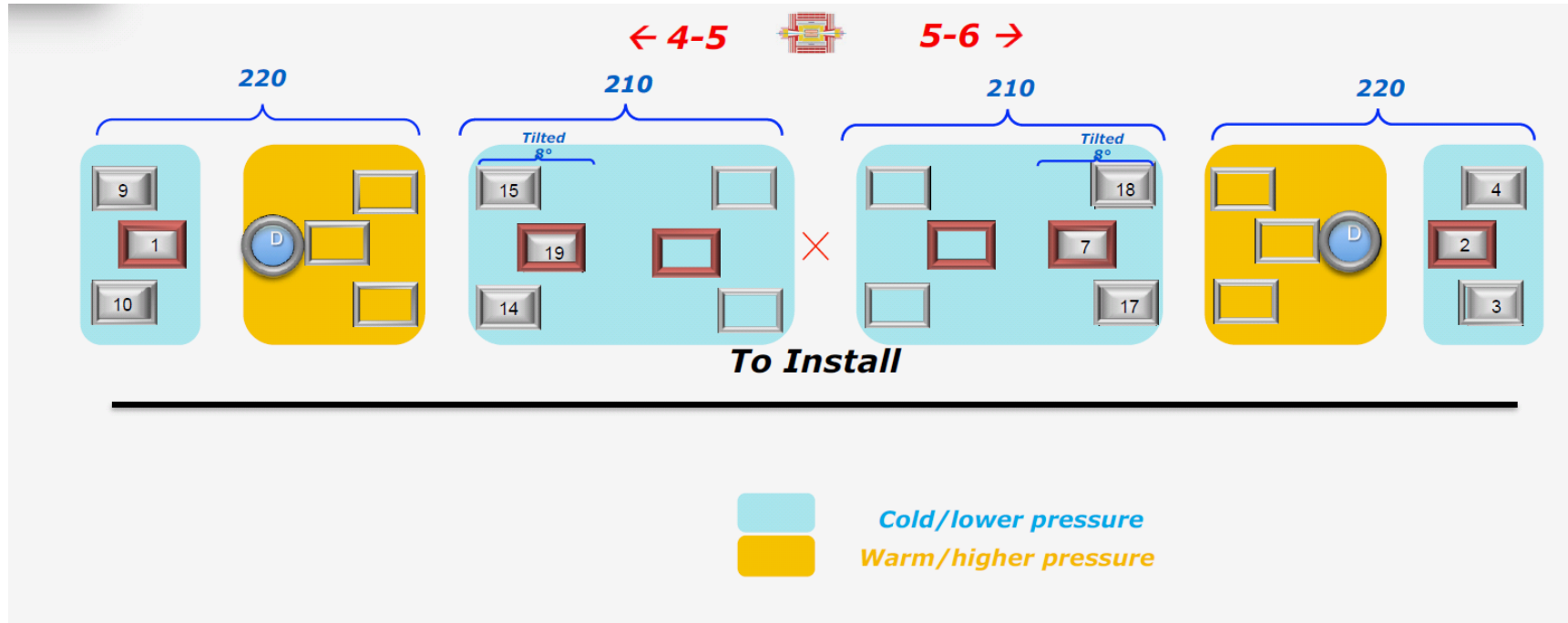
Received clock jitter - sec.5-6



Received clock jitter - sec.4-5



# EYETS: Cooling & vacuum



- New, independent cooling and vacuum lines installed in both sectors.
- Allow to operate the silicon strips and pixels at very low temperature
  - Improved lifetime
- Allow higher temperature for timing detectors

# EYETS: Readiness

Clpps Parameters Sector 45 Beam 2 Sector 56 Beam 1

Clpps Parameters NOTR

Parameter	20c1_hr	20fr_tp	20fr_bt	20fr_hr	10fr_tp	10fr_bt	10fr_hr	10fr_bt	10fr_tp	20fr_hr	20fr_bt	20fr_tp	20c1_hr				
LvA [V]	0.03	0.03	0.03	0.05	0.03	0.04	0.01	0.02	0.03	0.02	0.04	0.04	2.58	1.82			
LvA [A]	0.27	0.27	0.27	0.33	0.28	0.27	0.04	0.03	0.04	0.30	0.26	0.29	0.42	0.95			
LvD [V]	0.03	0.03	0.03	0.03	0.28	0.27	0.06	0.00	0.02	0.03	0.03	0.04	0.05	0.03			
LvD [A]	0.27	0.27	0.27	0.27	0.28	0.27	0.04	0.04	0.04	0.32	0.27	0.29	0.31	0.33			
Rep [V]	0.08	Con [V]	0.03	Con [V]	0.03	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.06	Con [V]	0.05	Rep [V]	0.06
Rep [A]	0.27	Con [A]	0.27	Con [A]	0.27	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.29	Con [A]	0.32	Rep [A]	0.31
Hv [V]	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Hv [uA]	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Temp01 [°C]	20.99	0.00	Acknowledge All		-24.73	-23.17	0.00	-24.79	-25.08	-22.83	-23.12	-24.64	-24.09	-1.1	-22.88	-24.21	0.00
DssTemp [°C]	19.44	9.70	-24.15	-22.97	-19.08	-22.90	-23.14	-23.01	-23.59	-23.99	-23.63	-14.02	-22.46	-22.67	-22.46	-22.67	11.03
CoolLeftIn [°C]			-26.72	-26.89	-26.82	-27.48	-22.27	-22.23	-12.28	-21.91	-23.01	-24.03	-22.98	-22.81	-24.26	-24.76	
CoolLeftOut [°C]			-28.98	-19.61	-23.48	-23.48	-22.20	-23.03	-23.11	-22.81	-23.08	-24.23	-25.90	-25.90	-27.84	-26.21	
CoolRightIn [°C]	1.39		-27.64	-27.59	-22.31	-25.86	-22.78	-23.29	-7.81	-21.20	-22.33	-21.72	-24.18	-22.38	-24.74	-24.88	1.13
CoolRightOut [°C]	2.33		-28.06	-29.00	-27.65	-28.00	-22.66	-22.98	-19.70	-23.26	-21.39	-21.52	-22.76	-26.08	-26.13	-26.55	1.76
RadTemp [°C]	17.60		15.05		14.58		22.11			15.18			17.51		18.83		12.09
Vacu01 [mbar]	105.99		16.00	19.51	31.90		20.58	18.78	18.46	20.80	23.76	23.23	19.98		21.00	19.77	107.96
Leak [uA]	+0.00		+0.00	+0.18	+0.00		+0.00	+0.00	+0.00	+0.00	+0.21	+0.00	+0.00		+0.00	+0.00	+0.00
Pressure [mbar]	97.69				13.67								19.02				108.69
RPIn	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RPHome	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RPOut	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RPMotorPowerOn	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
RPAntiCollision	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●
PosSetting [um]	+35000		+35000	-35000	+35000		+35000	-35000	+35000	+35000	-35000	+35000	+35000	-35000	+35000		
LVDT [um]	+43632		+41881	-41596	+41733		+43261	-42267	+41872	+40032	-42085	+41832	+44077	-43104	+42587		
Motor [um]	+41198		+34998	-35001	+34999		+34999	-35001	+34998	+35000	-35001	+34998	+34999	-34999	+35000		
Resolver [um]	+43620		+41850	-41555	+41488		+43250	-42179	+41890	+40068	-42021	+41811	+44104	-43111	+42585		
InnWarning [um]	+36000		+36000	-36000	+36000		+36000	-36000	+36000	+36000	-36000	+36000	+36000	-36000	+36000		
InnCritical [um]	+35000		+35000	-35000	+35000		+35000	-35000	+35000	+35000	-35000	+35000	+35000	-35000	+35000		
InnLimit [um]	-5000		-5000	+5000	-5000		-5000	+5000	-5000	-5000	+5000	-5000	-5000	+5000	-5000		
OutWarning [um]	+45000		+45000	-45000	+45000		+45000	-45000	+45000	+45000	-45000	+45000	+45000	-45000	+45000		
OutCritical [um]	+46000		+46000	-46000	+46000		+46000	-46000	+46000	+46000	-46000	+46000	+46000	-46000	+46000		
RPState	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RPWarning	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
RPErrors	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Detector temperature and vacuum parameters

LHC vacuum parameters

**FESASStatus**

totFESAState 0

totFESAInfoID 3

totFESAWarning 8

totFESAAAlarmID 0

**PXIStatus**

totPXIInfoID 0

totPXIAlarmID 0

**lhcVacuum**

VGPB/2/6L5/R 3.60e-011

VGPB/2/6R5/B 4.00e-011

VGPB/4/6L5/R 2.30e-011

VGPB/4/6R5/B 2.10e-011

VGI/77/6L5/R 7.90e-012

VGI/77/6R5/B 4.20e-012

VGPB/232/6L5/R 8.40e-011

VGPB/232/6R5/B 8.20e-011

VGPB/235/6L5/R 7.10e-011

VGRB/235/6R5/B 9.20e-011



# EYETS: Readiness

- Re-commissioning with Mini-DAQ – high rate rand. trigger w. RSync fast-com.
  - Si-Strip **OK**
  - Timing **OK**
  - Pixels ( $\mu$ TCA back-end) **OK**
- All detectors ready for DAQ integration test with CMS – starting this week
- Offline: reconstruction and data quality monitor integrated in CMSSW

# Conclusions

- EYETS activities successfully concluded
- CT-PPS spectrometer ready to take data with 4 detector technologies
  - Si-Strips and Si-Pixels allowing tracking with improved resolution and radiation hardness
  - Diamonds and UFSD allowing timing measurements – with precise clock at  $\sim 2\text{ps}$
- Coming soon:
  - DAQ commissioning with CMS central detector – this week
  - First alignment run – planned on May 26<sup>th</sup>